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AVOIDING THE PITFALLS WHEN COATING WITH HOT MELT ADHESIVES

Mike Budai
Coating and Laminating Manager
ITW Dynatec
Hendersonville, TN

Business management-Bowling Green State University. Worked with Teledyne Corporation developing several patents on Hydro-Pneumatic cylinder systems. Worked with Wright Industries as a sales engineer developing proposals and ROI analysis for automated assembly and process systems. Currently the coating and Laminating manager with ITW Dynatec designing thermo-plastic polymer laydown systems for both coating and laminating. Recent patents for developing new fine fiber distribution. Has served on the board of directors for INDA(International trade association for non wovens).

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Author: Michael Budai
Coating and Laminating Manager
ITW Dynatec
Hendersonville, TN

The purpose of this paper is to learn what to look for in equipment and in processes when designing a hot melt coating system so you will avoid the pitfalls that some have fallen into. Consistent quality requires repeatable process and repeatable process requires repeatable parameters. This paper will examine the typical parameters viewed with hot melt applications and the equipment that surrounds them.

The Adhesive

The type, size, and shape of the adhesive play a huge role in the coating system design of the equipment and the equipment type. Beware of adhesives that come in bags that they say can be thrown directly into a melter. These bags have a different viscosity and different chemical makeup than the adhesive and can clog filters. Many factors help determine the melt rate of adhesives:

- The size and shape of the adhesive as it goes into the melter. The smaller the configuration such as pastelles or pellets, the higher the melt rate. The reason is because melt rate in any melter is determined by surface area (contact area) times the wattage of the heater grids in the melter. For example if the adhesive were to come in blocks, then these blocks would sit on top of the heater grids and greatly reduce the contact area resulting in the lower melt rate.
- Viscosity, softening point (ring and ball), and whether the adhesive is more crystalline or amorphous in nature. In general the higher the softening point and the higher the viscosity at temperature, then the lower the melt rate of the adhesive. In many cases when the adhesive comes in small shapes such as pellets, chicklets, or pastelles, then there are devices out on the market called hopper feeders to automatically feed the melter with the adhesive from a Gaylord or supersack.

Figure 1: Adhesive Shapes

Figure 2: Adhesive Shapes

One other important note about the hot melt adhesives is the ability to add important ingredients that may provide some additional features to your product such as anti-microbials, flame retardants, anti-Oxidants, UV inhibitors, etc. Ultimately it provides additional marketing benefits to your product.

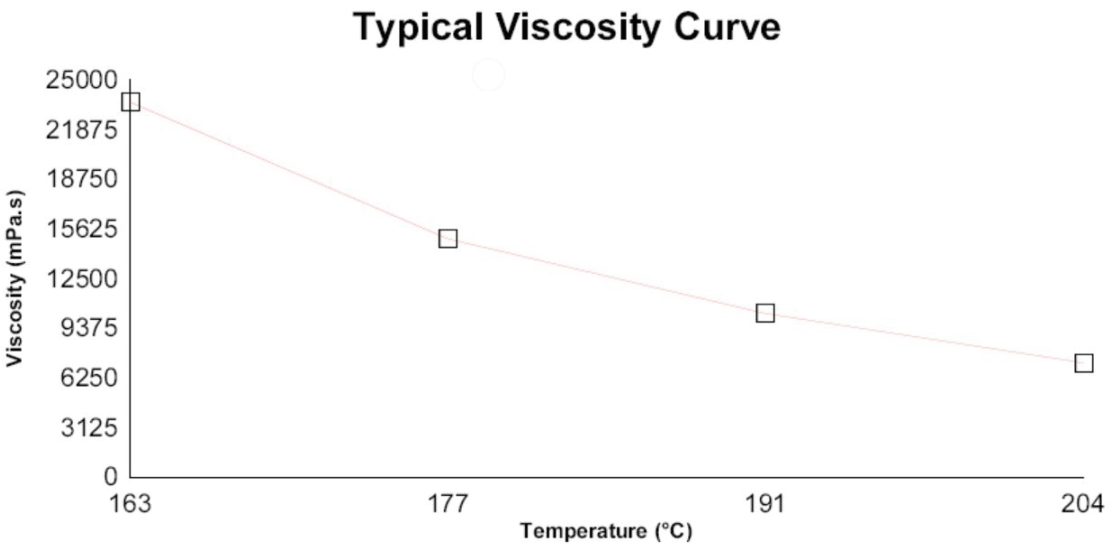

Figure 3: Viscosity Chart

Drum Unloaders

This is an essential piece of equipment in most coating lines.

Figure 4: Drum Unloader

If the adhesive comes in drums, then this identifies one of the essential pieces of initial equipment- a drum unloader. A drum unloader is a device with a heated platen that seals to the inside of the drum and

is lowered in the drum typically by pneumatic cylinders. The platen melts about 6-8 inches of the adhesive and has some type of pump on the back side of the platen to deliver the heated fluid to another device called a melter or adhesive supply unit. You do not pump from a drum unloader directly to an applicator because fluids require resonance time to heat stabilize the fluid before pumping to the applicator. A drum unloader does not allow sufficient time to heat stabilize a fluid.

Important note: the output of a drum unloader is determined by the melt rate of the particular adhesive coupled with the output rate of the particular pump used. Please make sure no manufacturer promises an output rate on a drum unloader without detailed information on the particular adhesive being used. As a matter of fact the only way to really know the intended output rate is to run a melt rate test, by the equipment manufacturer, on the adhesive being used with the intended drum unloader. Please note that the temperatures on the screen reflect the temperature of the thermocouple or RTD and not necessarily the fluid itself.

Look for several crucial specifications in a drum unloader:

- Automatic purging for burping the air out of the drum
- Good PLC for interface to your parent machine
- High platen surface area for maximum contact points with the adhesive
- High wattage for maximum melt rates
- Full clamshells for safety when working with fiber drums
- Good seals for wiping the drums clean
- Good design for minimizing the residual left in the drum when empty
- Has an interface for communicating with a level controller in a melter

Melters (Adhesive supply units)

The important criteria for sizing the melter are dependent on a lot of variables. To determine the proper size of the melter, we must first establish the output volume needed for the application. This is done with the following formula. Multiply the coat weight in MIL by the web speed in feet per minute by the width of the coating in inches by a multiplier of .026 equals the output required in pounds per hour. Example: coat weight(1 Mil) x web speed 300FPM x 48” wide x .026 = 375 Lbs of adhesive per hour.

First variable to look at is does the melter have to melt the adhesive from a solid or is it receiving fluid i.e. from a drum unloader(s). If it is receiving molten fluid from drum unloader(s) then the tank must be sized large enough to heat stabilize the fluid to the application temperature as recommended by the manufacture of the adhesive at the given output rate. The hopper must also have enough volume in it to be able to change out a drum of adhesive from a drum unloader without disrupting production.

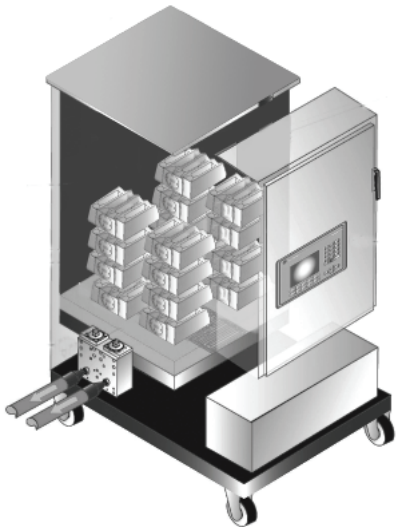

Figure 5: Melter with Heater Grids

When looking at a melter to melt an adhesive from a solid, different parameters are required.

Melting from a solid requires a much larger melter. To increase melt rate of an adhesive, decrease the size of the adhesive pieces (contact your adhesive supplier) as they enter the melter. The melter has to be sized such that the temperature will be exactly the same with the output rate no matter when it is measured.

Remember the adhesive needs to be brought from room temperature to the application temperature (let's say 375◦F) and be pumped out of the melter consistently at that temperature. This means that anywhere you measure the fluid temperature, it should be at 375◦F. Again the temperature on the HMI screen does not reflect the actual temperature of the adhesive but rather the temperature of the heater grids themselves. If the adhesive does not have enough resonance time in contact with the heater grids, it will not come up to temperature.

Figure 4: Heater Grid

The only type of melters you should consider are melt-on-demand. What this means is that the melter does not apply heat to the adhesive until there is a demand for it. The tank walls should not be heated but rather all the heat should be applied to the adhesive as it passes by the heater grids. The heater grids should be compared by surface area, wattage, and the quantity of grids.

Poor melter design on the front end can result is temperature variations as it reaches the applicator. One common scenario is that in the morning, when a shift starts, the system seems to run fine. Then later in the day the product seems to change. The reason is because when the system has warmed up and is just starting, all the fluid in the melter is heat stabilized and therefore the product is consistent. Later in the day the melter can't keep the fluid stabilized based on demand, and therefore the fluid temperature dropped and the viscosity went up, which changed the laydown onto the substrate.

Immersion Sensors and Pressure Transducers

As stated in the beginning of this paper, we need to focus on repeatable parameters to result in consistent quality. Some additional items that should be part of every good coating process for hot melt applications are immersion sensors and pressure transducers.

The immersion sensor actually measures the temperature in the fluid stream as opposed to the temperature of the heater grid. This gives a very true reading. The immersion sensor should be placed right before the applicator, and ideally, it should be wired with a PID loop to automatically adjust the temperature of the melter grid based on its readings until the sensor reaches what is called steady state.

The pressure transducer should also be mounted right before the applicator. When using a slot die each die has an ideal back head pressure based on the die design and the rheology of the particular fluid. This device also can be placed in a PID loop with the pump motors to automatically adjust the RPMs to maintain a constant exact back head pressure.

Additional Considerations

Another feature that should be part of a good design is what is called line speed tracking. This is a feature in the PLC that can pull a signal off the main drive motors on the line (4-20 milliamp or 0-10volt) and automatically adjust the RPMs of the pump motors to compensate for any variation in web speed. Line speed tracking ensures that the net coat weight never changes regardless of the variation in web speed.

One other item that should be considered in design of a good hot melt coating system is a ball valve right at the slot die. If the slot die is designed so that the attitude of the die is 15 degrees below horizontal, then the internal manifold will remain full of fluid even when the system is not running. The purpose of the ball valve is to manage a short stop such as a roll change: you can automatically close the ball valve via an air actuator when there is a line stop, but keep the pumps on maintaining the back head pressure right at the entrance to the die. When the line is restarted, the ball valve can be opened and you end up with virtually instant good coating, minimizing any scrap. During this sequence it is important that the melter be designed with safety in mind. Pressure relief valves are crucial components that re-circulate any excess pressure in the heated hoses back to the melter tank to prevent excess pressure. In a long stop, the ball valve would automatically close and the pumps would shut off.

Following these guidelines will go a long way to creating a system that will provide the consistent quality that everyone is striving for.